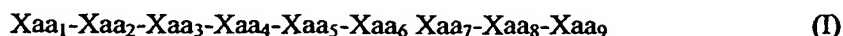


**WHAT IS CLAIMED:**

1. A composition for inhibiting growth of chondrosarcoma cells comprising an effective amount of a peptide of formula I and a pharmaceutically acceptable carrier:

5



wherein:

10 Xaa<sub>1</sub>, Xaa<sub>4</sub>, and Xaa<sub>6</sub> are separately each apolar amino acids;

Xaa<sub>2</sub> is a basic amino acid;

Xaa<sub>3</sub> is a cysteine-like amino acid;

Xaa<sub>5</sub> is a polar or aliphatic amino acid;

Xaa<sub>7</sub> is an acidic amino acid;

Xaa<sub>8</sub> is an aliphatic or polar amino acid; and

15 Xaa<sub>9</sub> is an aliphatic, apolar or basic amino acid.

2. A composition for inhibiting growth of chondrosarcoma cells comprising an effective amount of a peptide of formula II and a pharmaceutically acceptable carrier:



wherein:

Xaa<sub>10</sub> is a polar, acidic, basic or apolar amino acid;

Xaa<sub>11</sub> is a polar or aromatic amino acid;

Xaa<sub>12</sub> is a polar, basic, aliphatic or apolar amino acid;

25 Xaa<sub>13</sub> is an aromatic, aliphatic, polar or acidic amino acid;

Xaa<sub>14</sub> is an aromatic, apolar or polar amino acid;

Xaa<sub>15</sub> is an apolar or acidic amino acid;

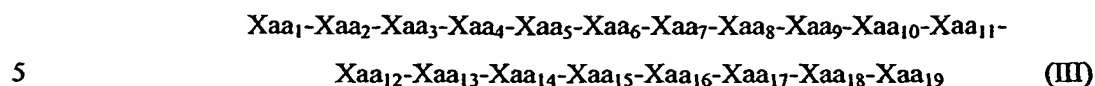
Xaa<sub>16</sub> is a basic, a polar or an apolar amino acid;

Xaa<sub>17</sub> is a basic, a polar, an aliphatic, an apolar or an acidic amino acid;

30 Xaa<sub>18</sub> is an apolar or an aliphatic amino acid; and

Xaa<sub>19</sub> is a basic or an aliphatic amino acid.

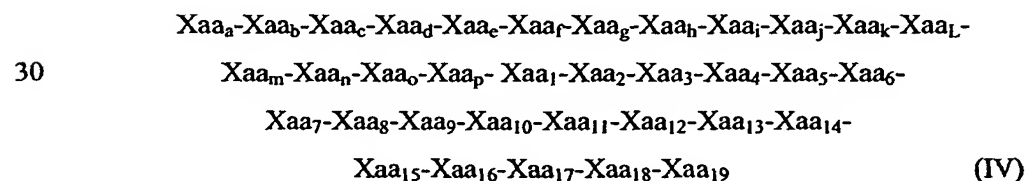
3. A composition for inhibiting growth of chondrosarcoma cells comprising an effective amount of a peptide of formula III and a pharmaceutically acceptable carrier:



wherein

- Xaa<sub>1</sub>, Xaa<sub>4</sub>, and Xaa<sub>6</sub> are separately each apolar amino acids;  
 Xaa<sub>2</sub> is a basic amino acid;  
 Xaa<sub>3</sub> is a cysteine-like amino acid;  
 10 Xaa<sub>5</sub> is a polar or aliphatic amino acid;  
 Xaa<sub>7</sub> is an acidic amino acid;  
 Xaa<sub>8</sub> is an aliphatic or polar amino acid;  
 Xaa<sub>9</sub> is an aliphatic, apolar or basic amino acid;  
 Xaa<sub>10</sub> is a polar, acidic, basic or apolar amino acid;  
 15 Xaa<sub>11</sub> is a polar or aromatic amino acid;  
 Xaa<sub>12</sub> is a polar, basic, aliphatic or apolar amino acid;  
 Xaa<sub>13</sub> is an aromatic, aliphatic, polar or acidic amino acid;  
 Xaa<sub>14</sub> is an aromatic, apolar or polar amino acid;  
 Xaa<sub>15</sub> is an apolar or acidic amino acid;  
 20 Xaa<sub>16</sub> is a basic, a polar or an apolar amino acid;  
 Xaa<sub>17</sub> is a basic, a polar, an aliphatic, an apolar or an acidic amino acid;  
 Xaa<sub>18</sub> is an apolar or an aliphatic amino acid; and  
 Xaa<sub>19</sub> is a basic or an aliphatic amino acid.

- 25 4. A composition for inhibiting growth of chondrosarcoma cells comprising an effective amount of a peptide of formula IV (SEQ ID NO:18) and a pharmaceutically acceptable carrier:



- |    |   |  |
|----|---|--|
|    | Xaa <sub>a</sub> is proline;                        | Xaa <sub>1</sub> is proline;                     |
|    | Xaa <sub>b</sub> is glutamine or glutamic acid;     | Xaa <sub>2</sub> is arginine;                    |
|    | Xaa <sub>c</sub> is threonine;                      | Xaa <sub>3</sub> is cysteine;                    |
| 5  | Xaa <sub>d</sub> is glycine;                        | Xaa <sub>4</sub> is glycine;                     |
|    | Xaa <sub>e</sub> is aspartic acid or glutamic acid; | Xaa <sub>5</sub> is valine or asparagine;        |
|    | Xaa <sub>f</sub> is leucine;                        | Xaa <sub>6</sub> is proline;                     |
|    | Xaa <sub>g</sub> is aspartic acid;                  | Xaa <sub>7</sub> is aspartic acid;               |
|    | Xaa <sub>h</sub> is glutamine or serine;            | Xaa <sub>8</sub> is valine or leucine;           |
| 10 | Xaa <sub>i</sub> is asparagine or alanine;          | Xaa <sub>9</sub> is alanine or glycine;          |
|    | Xaa <sub>j</sub> is threonine;                      | Xaa <sub>10</sub> is asparagine or arginine;     |
|    | Xaa <sub>k</sub> is isoleucine or leucine;          | Xaa <sub>11</sub> is tyrosine or phenylalanine;  |
|    | Xaa <sub>L</sub> is glutamic acid or lysine;        | Xaa <sub>12</sub> is asparagine or glutamine;    |
|    | Xaa <sub>m</sub> is threonine or alanine;           | Xaa <sub>13</sub> is phenylalanine or threonine; |
| 15 | Xaa <sub>n</sub> is methionine;                     | Xaa <sub>14</sub> is phenylalanine;              |
|    | Xaa <sub>o</sub> is arginine;                       | Xaa <sub>15</sub> is proline or glutamic acid;   |
|    | Xaa <sub>p</sub> is lysine or threonine;            | Xaa <sub>16</sub> is arginine or glycine;        |
|    | Xaa <sub>17</sub> is lysine or aspartic acid;       | Xaa <sub>18</sub> is proline or leucine; and     |
|    | Xaa <sub>19</sub> is lysine.                        |  |
- 20
5. The composition of any one of claims 1-4, wherein an apolar amino acid is methionine, glycine or proline.
- 25
6. The composition of any one of claims 1-4, wherein a basic amino acid is histidine, lysine, arginine, 2,3-diaminopropionic acid, ornithine, homoarginine,  $\gamma$ -aminophenylalanine, and 2,4-diaminobutyric acid. The composition of any one of claims 1-4, wherein a cysteine-like amino acid is cysteine, homocysteine, penicillamine, or  $\beta$ -methyl cysteine.
- 30
7. The composition of any one of claims 1-4, wherein an aliphatic amino acid is alanine, valine, leucine, isoleucine, t-butylalanine, t-butylalanine, N-methylisoleucine, norleucine, N-methylvaline, cyclohexylalanine,  $\beta$ -alanine, N-methylglycine, or  $\alpha$ -aminoisobutyric acid.

8. The composition of any one of claims 1-4, wherein an acidic amino acid is aspartic acid or glutamic acid.
- 5 9. The composition of any one of claims 1-4, wherein a polar amino acid is asparagine, glutamine, serine, threonine, tyrosine, citrulline, N-acetyl lysine, methionine sulfoxide, or homoserine, or an apolar amino acid such as methionine, glycine or proline.
- 10 10. The composition of any one of claims 1-4, wherein an aromatic amino acid is phenylalanine, tyrosine, tryptophan, phenylglycine, naphthylalanine,  $\beta$ -2-thienylalanine, 1,2,3,4-tetrahydro-isoquinoline-3-carboxylic acid, 4-chlorophenylalanine, 2-fluorophenylalanine, 3-fluorophenylalanine, 4-fluorophenylalanine, pyridylalanine, or 3-benzothienyl alanine.
- 15 11. The composition of any one of claims 1-4 wherein the peptide inhibits proteinase activity of matrix metalloproteinase-1, matrix metalloproteinase-2, matrix metalloproteinase-3, matrix metalloproteinase-4, matrix metalloproteinase-5, matrix metalloproteinase-6, matrix metalloproteinase-7, matrix metalloproteinase-8, and  
20 matrix metalloproteinase-9, matrix metalloproteinase-10, matrix metalloproteinase-11, matrix metalloproteinase-12, or matrix metalloproteinase-13.
12. The composition of any one of claims 1-4 wherein inhibiting growth of  
25 chondrosarcoma inhibits growth of conventional chondrosarcoma, myxoid chondrosarcoma, mesenchymal chondrosarcoma, clear cell chondrosarcoma, or dedifferentiated (spindle cell) chondrosarcoma.
13. The composition of any one of claims 1-4 wherein inhibiting growth of  
30 chondrosarcoma cells inhibits growth of a bone tumor.
14. The composition of any one of claims 1-4, wherein inhibiting growth of chondrosarcoma cells diminishes a size of a bone tumor.

15. The composition of claim 12, 13 or 14, wherein the tumor is metastatic, non-metastatic, vascularized, non-vascularized, hard or soft.
16. The composition of any one of claims 1-4 wherein the peptide comprises SEQ ID NO:1, SEQ ID NO:2, SEQ ID NO:3, SEQ ID NO:4, SEQ ID NO:5, SEQ ID NO:6, SEQ ID NO:7, SEQ ID NO:8, SEQ ID NO:9, SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:12, or SEQ ID NO:13.
17. An anti-sarcoma composition that comprises a therapeutically effective amount of peptide that comprises SEQ ID NO:1, SEQ ID NO:2, SEQ ID NO:3, SEQ ID NO:4, SEQ ID NO:5, SEQ ID NO:6, SEQ ID NO:7, SEQ ID NO:8, SEQ ID NO:9, SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:12, or SEQ ID NO:13, and a pharmaceutically acceptable carrier, wherein the peptide is capable of inhibiting growth of chondrosarcoma cells.
18. A method for decreasing growth of chondrosarcoma cells that comprises contacting a chondrosarcoma cell with an effective amount of a peptide of formula I:



wherein:

Xaa<sub>1</sub>, Xaa<sub>4</sub>, and Xaa<sub>6</sub> are separately each apolar amino acids;

Xaa<sub>2</sub> is a basic amino acid;

Xaa<sub>3</sub> is a cysteine-like amino acid;

Xaa<sub>5</sub> is a polar or aliphatic amino acid;

Xaa<sub>7</sub> is an acidic amino acid;

Xaa<sub>8</sub> is an aliphatic or polar amino acid; and

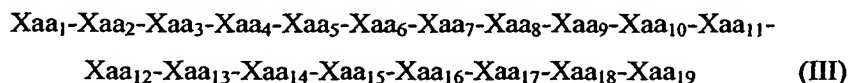
Xaa<sub>9</sub> is an aliphatic, apolar or basic amino acid.

19. A method for decreasing growth of chondrosarcoma cells that comprises contacting a chondrosarcoma cell with an effective amount of a peptide of formula II:



wherein:

- Xaa<sub>10</sub> is a polar, acidic, basic or apolar amino acid;  
 Xaa<sub>11</sub> is a polar or aromatic amino acid;  
 5 Xaa<sub>12</sub> is a polar, basic, aliphatic or apolar amino acid;  
 Xaa<sub>13</sub> is an aromatic, aliphatic, polar or acidic amino acid;  
 Xaa<sub>14</sub> is an aromatic, apolar or polar amino acid;  
 Xaa<sub>15</sub> is an apolar or acidic amino acid;  
 Xaa<sub>16</sub> is a basic, a polar or an apolar amino acid;  
 10 Xaa<sub>17</sub> is a basic, a polar, an aliphatic, an apolar or an acidic amino acid;  
 Xaa<sub>18</sub> is an apolar or an aliphatic amino acid; and  
 Xaa<sub>19</sub> is a basic or an aliphatic amino acid.
20. A method for decreasing growth of chondrosarcoma cells that comprises contacting  
 15 a chondrosarcoma cell with an effective amount of a peptide of formula III:



wherein:

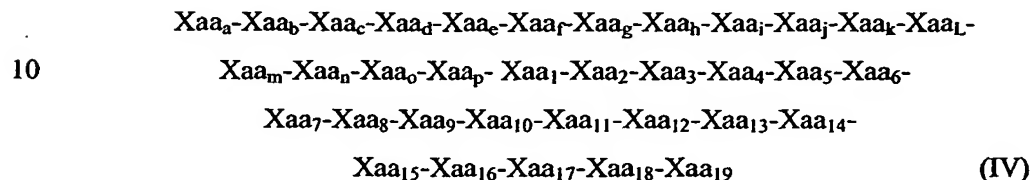
- 20 Xaa<sub>1</sub>, Xaa<sub>4</sub>, and Xaa<sub>6</sub> are separately each apolar amino acids;  
 Xaa<sub>2</sub> is a basic amino acid;  
 Xaa<sub>3</sub> is a cysteine-like amino acid;  
 Xaa<sub>5</sub> is a polar or aliphatic amino acid;  
 Xaa<sub>7</sub> is an acidic amino acid;  
 25 Xaa<sub>8</sub> is an aliphatic or polar amino acid;  
 Xaa<sub>9</sub> is an aliphatic, apolar or basic amino acid;  
 Xaa<sub>10</sub> is a polar, acidic, basic or apolar amino acid;  
 Xaa<sub>11</sub> is a polar or aromatic amino acid;  
 Xaa<sub>12</sub> is a polar, basic, aliphatic or apolar amino acid;  
 30 Xaa<sub>13</sub> is an aromatic, aliphatic, polar or acidic amino acid;  
 Xaa<sub>14</sub> is an aromatic, apolar or polar amino acid;  
 Xaa<sub>15</sub> is an apolar or acidic amino acid;  
 Xaa<sub>16</sub> is a basic, a polar or an apolar amino acid;

Xaa<sub>17</sub> is a basic, a polar, an aliphatic, an apolar or an acidic amino acid;

Xaa<sub>18</sub> is an apolar or an aliphatic amino acid; and

Xaa<sub>19</sub> is a basic or an aliphatic amino acid.

- 5 21. A method for decreasing growth of chondrosarcoma cells that comprises contacting a chondrosarcoma cell with an effective amount of a peptide of formula IV (SEQ ID NO:18):



wherein:

- |    |   |  |
|----|---|--|
| 15 | Xaa <sub>a</sub> is proline;                        | Xaa <sub>1</sub> is proline;                     |
|    | Xaa <sub>b</sub> is glutamine or glutamic acid;     | Xaa <sub>2</sub> is arginine;                    |
|    | Xaa <sub>c</sub> is threonine;                      | Xaa <sub>3</sub> is cysteine;                    |
|    | Xaa <sub>d</sub> is glycine;                        | Xaa <sub>4</sub> is glycine;                     |
|    | Xaa <sub>e</sub> is aspartic acid or glutamic acid; | Xaa <sub>5</sub> is valine or asparagine;        |
| 20 | Xaa <sub>f</sub> is leucine;                        | Xaa <sub>6</sub> is proline;                     |
|    | Xaa <sub>g</sub> is aspartic acid;                  | Xaa <sub>7</sub> is aspartic acid;               |
|    | Xaa <sub>h</sub> is glutamine or serine;            | Xaa <sub>8</sub> is valine or leucine;           |
|    | Xaa <sub>i</sub> is asparagine or alanine;          | Xaa <sub>9</sub> is alanine or glycine;          |
|    | Xaa <sub>j</sub> is threonine;                      | Xaa <sub>10</sub> is asparagine or arginine;     |
| 25 | Xaa <sub>k</sub> is isoleucine or leucine;          | Xaa <sub>11</sub> is tyrosine or phenylalanine;  |
|    | Xaa <sub>L</sub> is glutamic acid or lysine;        | Xaa <sub>12</sub> is asparagine or glutamine;    |
|    | Xaa <sub>m</sub> is threonine or alanine;           | Xaa <sub>13</sub> is phenylalanine or threonine; |
|    | Xaa <sub>n</sub> is methionine;                     | Xaa <sub>14</sub> is phenylalanine;              |
|    | Xaa <sub>o</sub> is arginine;                       | Xaa <sub>15</sub> is proline or glutamic acid;   |
| 30 | Xaa <sub>p</sub> is lysine or threonine;            | Xaa <sub>16</sub> is arginine or glycine;        |
|    | Xaa <sub>17</sub> is lysine or aspartic acid;       | Xaa <sub>18</sub> is proline or leucine; and     |
|    | Xaa <sub>19</sub> is lysine.                        |  |

22. The method of any one of claims 18-21, wherein the peptide comprises SEQ ID NO:1, SEQ ID NO:2, SEQ ID NO:3, SEQ ID NO:4, SEQ ID NO:5, SEQ ID NO:6, SEQ ID NO:7, SEQ ID NO:8, SEQ ID NO:9, SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:12, or SEQ ID NO:13.
- 5
23. The method of any one of claims 18-21, wherein the peptide comprises SEQ ID NO:11.
24. The method of any one of claims 18-21, wherein an apolar amino acid is methionine, glycine or proline.
- 10
25. The method of any one of claims 18-21, wherein a basic amino acid is histidine, lysine, arginine, 2,3-diaminopropionic acid, ornithine, homoarginine,  $\alpha$ -aminophenylalanine, and 2,4-diaminobutyric acid.
- 15
26. The method of any one of claims 18-21, wherein a cysteine-like amino acid is cysteine, homocysteine, penicillamine, or  $\beta$ -methyl cysteine.
27. The method of any one of claims 18-21, wherein an aliphatic amino acid is alanine, valine, leucine, isoleucine, t-butylalanine, t-butylalanine, N-methylisoleucine, norleucine, N-methylvaline, cyclohexylalanine,  $\beta$ -alanine, N-methylglycine, or  $\alpha$ -aminoisobutyric acid.
- 20
28. The method of any one of claims 18-21, wherein an acidic amino acid is aspartic acid or glutamic acid.
- 25
29. The method of any one of claims 18-21, wherein a polar amino acid is asparagine, glutamine, serine, threonine, tyrosine, citrulline, N-acetyl lysine, methionine sulfoxide, or homoserine, or an apolar amino acid such as methionine, glycine or proline.
- 30
30. The method of any one of claims 18-21, wherein an aromatic amino acid is phenylalanine, tyrosine, tryptophan, phenylglycine, naphthylalanine,  $\beta$ -2-



thienylalanine, 1,2,3,4-tetrahydro-isoquinoline-3-carboxylic acid, 4-chlorophenylalanine, 2-fluorophenylalanine, 3-fluorophenylalanine, 4-fluorophenylalanine, pyridylalanine, or 3-benzothienyl alanine.

5    31.    The method of any one of claims 18-21, that further comprises locally administering the peptide to a tumor in a mammal.

32.    The method of claim 31, wherein the tumor is metastatic, non-metastatic, vascularized, non-vascularized, hard or soft.

10

33.    The method of any one of claims 18-21, wherein decreasing growth of chondrosarcoma cells decreases growth of conventional chondrosarcoma, myxoid chondrosarcoma, mesenchymal chondrosarcoma, clear cell chondrosarcoma, or dedifferentiated (spindle cell) chondrosarcoma.